Government of Canada / Gouvernement du Canada

Environmental Assessment Review / Examen des évaluations environnementales

Ottawa, Ontario
K1A 0H3

August, 1980

Dear Sir/Madam:

I am pleased to forward the most recent submission(s) received by the Norman Wells Environmental Assessment Panel. As additional information becomes available, it will be made available to you.

Yours sincerely,

R.L. Greyell
Executive Secretary
Norman Wells Pipeline Project

Energy, Mines and Resources Canada | Énergie, Mines et Ressources Canada

Science and Technology | Science et Technologie

Sir William Logan Building,
580 Booth Street,
Ottawa, Ontario K1A 0E4

18 August, 1980

Dr. P.J. Duffy,
Chairman,
Environmental Assessment Panel for
Norman Wells Project,
Department of Environment,
P.O. Box 146,
Yellowknife, N.W.T.
X1A 2N1

Dear Dr. Duffy:

Attached is a brief submitted by this Department to the Environmental Assessment Panel for purposes of the Panel's review of the proposed Norman Wells oilfield expansion and pipeline construction. Our comments relate primarily to earth science concerns. You will note that we have also provided a general statement reflecting the extent to which the proposal is in keeping with broad national energy objectives.

The geological and geotechnical information available to the proponent and the Panel is voluminous, perhaps unprecedented in the history of pipeline construction in this country. This is a result of there having been two competing pipeline proposals for this region in the past, plus an interagency environmental-social research program to collect baseline information which cost in excess of $20 million. EMR scientists contributed significantly to not only the provision of baseline terrain information in the Mackenzie Valley but also to the identification of potential problems, such as frost heave and settlement, slope stability and other problems that face eventual production further north in the Beaufort Sea. This was nearly a decade ago.

We are pleased to note that most of the problems that have been addressed over the years by the various pipeline proposals, research programs, inquiries, environmental assessments, etc. have been raised by others for purposes of your review. In our brief we have tried to avoid too much repetition of the concerns raised by others. Your Panel may want an expert from EMR to discuss some particular earth science phenomenon. While many of our scientists who worked on the Mackenzie Valley Program are no longer with us, we will make every effort to accommodate any request. I take note of the fact that your Panel includes one such individual from EMR, Mr. Alan Heginbottom.

Yours truly,

R.G. Skinner,
Head,
Office of Environmental Affairs

Enc.

BRIEF

PRESENTED BY

ENERGY, MINES AND RESOURCES

TO

ENVIRONMENTAL ASSESSMENT PANEL

FOR

PROPOSAL BY IMPERIAL OIL LTD. AND INTERPROVINCIAL

PIPELINES (NW) LTD.

NORMAN WELLS EXPANSION AND PIPELINE PROJECT

INTRODUCTION

The Department of Energy, Mines and Resources has been invited by the federal Environmental Assessment and Review Office to review and comment on the Environmental Impact Assessment prepared by Imperial Oil Ltd. and Interprovincial Pipeline (NW) Ltd. regarding their proposal to expand oil production facilities at Norman Wells and to construct a pipeline from Norman Wells to Zama, Alberta. EMR has two broad areas of expertise or responsibility on which to base comments on this project: I) the earth sciences, and II) national energy policy.

I Earth Sciences

EMR scientists who have reviewed the Environmental Impact Statement (EIS) have commented on the following subject areas.

A Oil field Expansion Component

1) Ice-jamming and stability of islands; island construction
2) Hydrologic data
3) Thermal performance of artificial islands
4) Hydrates

B Pipeline Component

1) Thermal and permafrost characteristics along route
2) Geotechnical aspects

A Oil Field Expansion Project

1) Ice jamming and stability of islands; island construction

The information available to EMR reviewers did not deal in any detail with the method of construction other than to say (Section 3.8.3.2, Vol. 2 of 4) that the method successfully employed for artifical islands in the Beaufort Sea will be employed. This involves the dumping of rock through an opening in the ice cover to lay out a horseshoe-shaped circumference for the eventual island. The horseshoe will be subsequently filled with sand from barges during the summer. The proponent does not indicate whether the major difference in unidirectional currents in the Beaufort Sea and the Mackenzie River will have any influence on the effectiveness of this technique for the river setting. Will there be scouring in front of the rock berm during construction, especially during spring breakup? What is the chance of large ice blocks foundering within the horseshoe enclosure, becoming buried in the alluvial sand to pose later construction problems and possible alterations in overall project schedule?

Security of the artifical island well head facilities is dependent on water and ice levels. Beaver Dredging's outline of the distribution of events (ice movement occurring at low water levels) is generally correct, however ice jams in the immediate vicinity of Norman Wells can cause significant elevations in water level. The ice jams appear to form sequentially in first the right then the left hand channels. The reduction in width in the right hand channel due to island construction can be expected to aggravate the jamming process. This is contrary to what the proponent's consultants state on page 2, Section 1.2 in the Report "Some Remarks Regarding Ice Jamming and the Design of Islands in the Mackenzie River at Norman Wells". The report states: "Construction of artificial islands may yield unfavourable conditions for ice jamming".

2) Hydrologic data

Incomplete presentation of hydrologic data and the analytical procedures applied to them impedes technical evaluation of this aspect of the project. Although perhaps unavoidable, the availability of only 7 years of useful flow data renders accurate and reliable extrapolation to long return periods somewhat doubtful. Evaluation by EMR scientists of the same data employing a differently shaped curve resulted in a 50-year maximum flow of approximately 45,000 m^3/second. The use of a different technique for such extrapolation is no more valid than that used by the proponent. It simply indicates that the data are weak and a more conservative interpretation might be warranted.

Northwest Hydraulics believes, on the basis of comparison with regime equations that the Mackenzie River at Norman Wells is larger than expected, and hence sediment accumulation and gradually rising bed levels can be expected. However, there is sufficient documentation to suggest that "northern" rivers are characteristically larger in cross-section than would be anticipated from theoretical models.

Therefore, given the lack of precision in extrapolating the 50 year flood and given the unique characteristics of northern rivers, a conservative engineering approach might be justified.

3) Thermal performance of artifical islands

The information available to EMR reviewers did not indicate whether the proponent has adequately assessed the potential for frost penetration and the resultant development of new permafrost in the artificial islands. Imperial Oil has world leading expertise with this phenomenon from their experience in the Beaufort Sea. However, the Beaufort Sea islands were not designed as production facilities with a long life expectancy. For the Norman Wells case, would

frost penetration lead to heaving of sufficient magnitude to threaten the integrity of the island or of any structure on it? Would the presence of 'warm' pipelines and ditches in the presence of such permafrost lead to subsidence? How would such subsidence and/or heaving compare with the subsidence of the islands due to natural compaction expected over the life of the project?

4) Hydrates

Not an environmental concern, but nonetheless a potential problem, is the possibility of hydrates formation as a result of water injection. The temperature conditions measured in the Norman Wells area are such that there is a possibility that the injected water may combine with the free gas that is undoubtedly present in the reservoir to form hydrates, blocking the pores near the injection wells. Composition of gas in the field, which is unknown to the reviewers, is also a factor that affects the likelihood of hydrate formation. The presence of hydrates could reduce the effective porosity of the rocks in the vicinity of the wells and thereby reduce the effectiveness of the pumping.

There is also the possibility that the water may combine with the volatiles in the oil itself to form hydrates which could encapsulate globules of oil. This denudation of the oil could effectively remove it from the production pool. There are examples such as the Umiat Field in the NPR of Alaska where oil of composition similar to that of Norman Wells appears denuded of volatiles, possibly indicating natural hydrate formation.

B Pipeline Component

1. Thermal and permafrost characteristics along route

Considerable information is available on the general geological characteristics of different soil and terrain units along the proposed route of the pipeline. Much of this information comes from earlier pipeline studies in the Mackenzie Valley. Route maps in Volume 3(c) show the locations of boreholes and general descriptions of terrain units including their tendency to contain ice. Lacking, however, are detailed thermal data. This is of special concern in view of the proposal to pump the oil at ground temperature. Because the route is through the Discontinuous Permafrost Zone, ground temperatures along the route will vary above and below 0°C. Clearly it would not be practical to vary the temperatures of the oil to match these varying temperatures, but in the absence of some detailed thermal analysis, to plan to pump at "ground temperature" would appear to be simplistic. EMR experts believe that frost heave and/or subsidence should be anticipated. What construction plans are proposed to accommodate these phenomena?

2. Geotechnical aspects

We note and endorse the comments and questions submitted to the Panel by R.O. Van Everdingen and P.J. Williams with respect to geotechnical aspects. We would stress the need for typical goethermal and geotechnical profiles representative of the various terrain conditions along the route. Little information is provided on the geotechnical characteristics of the soils to be encountered, such as plasticity, moisture contents and ranges in variation of textural composition. While the proponent recognizes this inadequacy, it also makes any evaluation of the proposal exceedingly difficult. This is especially the case for construction methods on slopes, particularly at major river crossings. The proponent proposes to 'over-trench' and back-fill with well drained aggregate. Slope failure phenomena in ice rich materials in this region are complex. The proposed method would not appear to rule out the possibility of failure of the whole slope as opposed to just the back-filled portion. In other words, in the view of EMR scientists, while the construction method may stabilize the trench, it is unlikely that it would stabilize the whole slope.

Other geotechnical concerns include the potential for aufeis from springs and the threat of collapse in active Karst (as opposed to thermokarst) topography.

II National Energy Policy

Environmental Assessment Panels usually are requested by the public to discuss questions of 'need' for the project. In the case of energy related projects such as offshore exploration in the Arctic, Uranium Refineries, etc. the Department of Energy, Mines and Resources is invited to make a statement which places the proposal within some policy context.

In the case of the Norman Wells Project the following comments are offered for consideration by the Panel.

- The achievement of greater energy security through the reduction of Canada's unnecessarily high reliance on oil imports has been and continues to be a major goal of national energy policy. The increased production of domestic oil such as from Norman Wells will make a direct, though modest, contribution to this objective.

- An integral part of national energy policy, especially in frontier regions, is the effort to increase our knowledge of the economic resource potential. The Geological Survey of Canada indicates that, on the basis of seismic studies and other evaluation to date, the hydrocarbon potential in the area of the proposed project is promising.

- The increased development of the field at Norman Wells and the construction of transportation facilities to deliver oil to southern markets will stimulate additional exploratory activity in the area. This will contribute to a greater understanding of the resource potential there.

- Construction of oil pipeline systems in northern areas will require accommodation of national environmental, social and economic goals. From the perspective of energy policy, the present proposal offers an opportunity to expand our knowledge of and experience with such problems on a relatively small scale.

- Another major goal of national policy is to increase Canadian participation in the ownership, control and benefits of the energy industry. The fact that 50% of the profits from the Norman Wells project will accrue to the federal government is consistent with this goal.

SUMMARY

EMR's review of the EIS for the Norman Wells Project finds that certain information concerning thermal regimes, permafrost, geotechnical properties and hydrology is insufficient for EMR scientists to assess whether the proponent has minimized the risk of failure of some critical elements of the project. It is noted, however, that the Panel in a document dated July, 1980 has requested supplementary information relating to permafrost distribution. It is also understood that more detailed information concerning thermal regimes, hydrates and thermal performance of the islands may have been submitted to the National Energy Board or the Department of Indian Affairs and Northern Development for purposes of other approvals. Finally, the concerns expressed here, might be covered in information that EMR did not receive.

Overall, while we would have preferred to see more detail in the areas mentioned, none of the information gaps would appear to be so serious to call into question the integrity of the project as a whole. The fact that the information may not have come forward to the Panel may be more a reflection of the inadequacy of the overall government regulatory and review process than an insufficiency in the proponent's planning. It is often difficult for the proponent to ascertain whether an item is "environmental", "technical", or, "socio-economic" and therefore where to place the emphasis for a particular reviewing agency. Consequently, the proponent has to make a judgment as to how much data is enough. If too little data, he is labelled 'superficial'; if too much, he is accused of a 'snow job'.

Overall, from EMR's perspective, the project in strict energy-supply terms, is consistent with national policy. EMR scientists are prepared to consult with the Panel's experts and the proponent in examining the earth science concerns raised in this brief.

Office of Environmental Affairs
August 15, 1980

AUTHOR Canada. Energy, Mines and Resources Canada

TITLE Brief presented by Energy Mines and Resources to